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(71) Applicant: **FLEXcon Company, Inc.**
Spencer, Massachusetts 01562-2642 (US)

(72) Inventors:
- **Pennance, John R.**
  Paxton, Massachusetts 01612-1326 (US)
- **Bennett III, John D.**
  Princeton, Massachusetts 01541 (US)
- **Jarvis, William L.**
  Paxton, Massachusetts 01612-1231 (US)
- **Johnson, Kathleen M.**
  Princeton, Massachusetts 01541 (US)

(74) Representative: **Mossmark, Anders**
Albihns Patentbyra Göteborg AB
P.O.Box 142
401 22 Göteborg (SE)

(54) Labeling composite and method of labeling substrates

(57) A labeling composite and methods of producing and using same. The label has an information receiving first layer having a top surface onto which information is provided and a bottom surface. An adhesive second layer is provided on the bottom surface which accommodates the adherence of the first layer to a surface of a substrate, the adhesive second layer including substrate marking substance dispersed therein. The marking substance serves to mark the portions of the substrate surface covered by the second layer in a non-uniform manner providing a detectable image of the information upon removal of the composite of the first and second layers from the substrate surface.

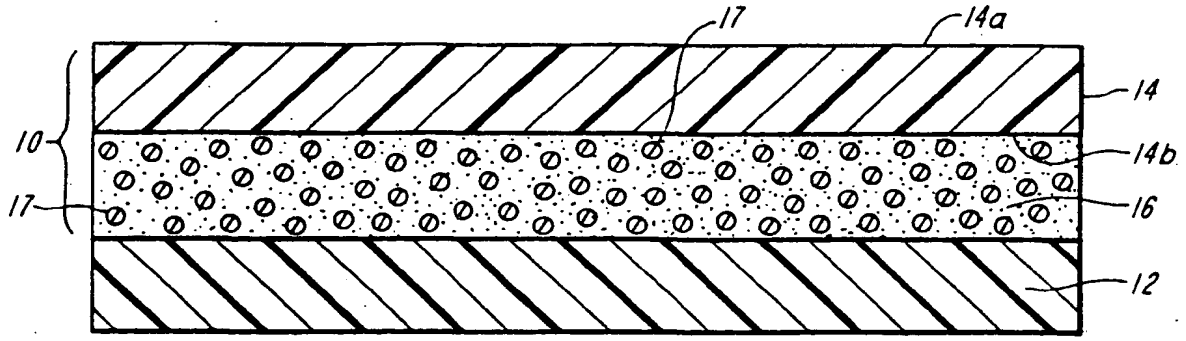

FIG. 1

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Description

BACKGROUND OF THE INVENTION

The invention relates to labeling in general, and more specifically to a new and improved label, which when removed from a substrate leaves a marking on the substrate which is an image of the information provided on the label.

Authentification labels, or tags, have undergone a change over the last 15 years. As the technology for replicating graphics has advanced, so has the need to enhance the authentification technology. Conventional color photocopiers, color printers and computers make the task of replicating authentification labels fairly easy and inexpensive.

Many authentification devices have been used to counteract this trend. These devices utilize holograms, chromic shifting inks, MICROTAGGANTS®, etc. For the most part, these systems have been replicated or at least replicated well enough to pass the inspection of the average trained inspector. An authentification label which uniquely identifies the specific tagged item has long been sought. The current technology relies on the use of a bar code or serial number, or other variable inputs which are printed on the surface of a label.

In certain circumstances, there is an additional requirement that the authentification label also be non-transferable (tamper evident) without some detectable, irreversible change. Examples of such tamper evident labels are described in U.S. Pat. App. Ser. No. 08/479,553 filed June 7, 1995 entitled "Tamper Evident Labeling", incorporated herein by reference.

SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide a labeling composite and method which has its variable input as a part of the physical structure of the label or tag itself. Furthermore, it is an object to have the label mark the substrate being labeled with the variable input or information provided to the label.

It is a further object of the invention to provide the ability to pre-mask a label material, apply the label to a substrate, and have the variable input on the label transferred or developed on the substrate. However, the variable input or indicia so transferred remains with the substrate even after the label is completely removed from the substrate.

It is yet another object of the invention to provide a label comprising a composite of at least two layers, one of the layers being physically alterable to receive and display information, and the other of the layers being adapted to adhere the label to a substrate and to indelibly transfer an image of the thus received information onto the substrate.

In accordance with one embodiment of the invention there is provided a labeling composite and method of producing same. The label has an information receiving first layer having a top surface onto which information is provided and a bottom surface. An adhesive second layer is provided on the bottom surface which accommodates the adherence of the first layer to a surface of a substrate, the adhesive second layer including substrate marking substance dispersed therein. The marking substance serves to mark the portions of the substrate surface covered by the second layer in a non-uniform manner providing a detectable image of the information upon removal of the composite of the first and second layers from the substrate surface.

In another embodiment of the invention there is provided a method of labeling. The method includes providing an information receiving first layer having a top surface onto which information is provided and a bottom surface. An adhesive second layer is applied on the bottom surface to define a composite label, the second layer accommodating the adherence of the first layer to a surface of a substrate, the second layer including substrate marking substance dispersed therein. The marking substance migrates to the substrate surface to mark the portions of the substrate surface covered by the second layer in a non-uniform manner providing a detectable image of the information upon removal of the composite label from the substrate surface. The composite label is applied to the substrate surface. The top surface of the first layer is physically altered to create the information thereon, the physical alteration of the top surface acting to alter the concentration of the marking substance within the adhesive layer in accordance with the information. The altered concentration of the marking substance results in a differential migration of the substance to the substrate surface and thus the substrate surface is marked with the image of the information.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross sectional view of an exemplary labeling composite in accordance with the invention;

Fig. 2 is a cross sectional view of the labeling composite as applied to a substrate and provided with information so as to mark the substrate with an image associated with the information provided to the label;

Fig. 3 is a cross sectional view of the marked substrate subsequent to removal of the labeling composite;

Fig. 4 is a cross sectional view of an alternative exemplary embodiment of the labeling composite of the invention provided with information prior to application to a substrate;

Fig. 5 is a cross sectional view of the labeling composite of Fig. 4 as applied to a substrate so as to mark the substrate with an image associated with the information provided to the label

Fig. 6 is a top view of an image marked on a substrate created with the labeling composite of Figs.

1-3;

Fig. 7 is a top view of an image marked on a substrate created with the labeling composite of Figs. 4 and 5;

Fig. 8 is a cross sectional view of an exemplary labeling composite utilizing a tamper evident labeling technique in combination with the invention; and

Fig. 9 is a cross sectional view of an alternative exemplary embodiment of the labeling composite of the invention provided with a layer for blocking migration of marking substance within the adhesive layer.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

Fig. 1 shows a cross sectional view of an exemplary composite label 10 as provided to an end user. The label is initially configured on a removable release liner 12, which is constructed from any one of many conventionally available label release liners, such as Special 50K-8 liner available from Flexcon Co., Inc. of Spencer, MA.

The label 10 includes an information receiving layer or film 14 having a top surface 14a onto which information, such as an image, indicia or other variable input is provided, and a bottom surface 14b. The top layer 14 of the invention includes, but is not limited to, films of polyethylene terephthalate, polyethylene, polypropylene, polystyrene (impact and general purpose), polyacrylic, polyvinyl chloride, various papers (cellulosics), etc.

An adhesive layer 16 is provided on the bottom surface 14b for adhering of the label to the surface of a substrate. In accordance with the invention, the adhesive layer 16 includes a substrate marking substance 17 dispersed therein. The substance 17 is shown diagrammatically for illustrative purposes. Within the adhesive layer there is incorporated, for example, dyes or other conventionally known reactive marking systems. The marking substance can either be visible under visible light or require special irradiation to view. The marking substance preferably provides a permanent or indelible mark on the substrate to which it is applied. In one exemplary embodiment, the marking substance is a monomeric dye that has a relatively low molecular weight, which in turn allows for flowing and migration of the dye through the adhesive layer and penetration into the substrate being labeled. For example, it has been found that an ultra-violet (UV) fluorescent dye conventionally available as Uvitex® will operate in accordance with the invention with pressure sensitive adhesives such as acrylic pressure sensitive adhesive V-23 available from Flexcon Co., Inc.

The thicknesses of all of the figures illustrating the invention have been exaggerated for illustrative purposes. In actual embodiments, thicknesses range from about .5 to 7 mils for the information receiving layer, .2 to 8 mils for the adhesive layer, and 1 to 8 mils for the release liner.

With reference to Fig. 2, the label 10 of the invention is shown applied to a substrate 18. To displace the adhesive and marking substance into the pattern of the image to be transferred, the label must be physically altered in some way. An example would be to die cut or punch out the variable information from the label material itself, or to otherwise ablate or deform the surface or the label via impact printing or a directed thermal energy source, such as a laser.

As shown in the exemplary embodiment of Fig. 2, information 20 is imparted to the layer 14 by ablating the label with a laser light source. In this configuration, the information, such as indicia, is cut or burned out of the layer 14 and adhesive layer 16 following the application of the label 10 to the substrate 18. The ablations 21 to the label function to alter the concentration of the marking substance within the adhesive layer 16 as at 22. In this case the marking substance is forced closer to the substrate surface and evaporated onto the substrate surface 18a. The altered concentration 22 of the marking substance thus results in an enhanced migration of the marking substance to the substrate surface. It will be appreciated by those of skill in the art that the altered concentration 22 of the marking substance replicates an image associated with the information 20 provided to the layer 14. As more marking substance migrates to the substrate surface, the surface is marked with a detectable image 24 of the information.

The marking substance serves to mark the portions of the substrate surface covered by the adhesive layer in a non-uniform manner providing the detectable image 24 of the information 20 upon removal of the composite label from said substrate surface as shown in Fig. 3. It will be understood that the entire surface of the substrate which is covered by the adhesive layer 16 will be marked with a "footprint". Thus, for example, the marked area will comprise a lightly shaded footprint 25 outlining the entire adhesive layer and the more vivid image 24 associated with the information 20 caused by the altered concentration 22 of the marking substance.

The transferred image 24 (information such as a variable input or indicia) can either be covert, thus requiring a special device to detect, or overt, thus easily detected by visual inspection, or a combination of both. The resulting transferred image can be designed to bond to the substrate surface, or, in those cases in which the substrate has a permeable surface layer, actually have the image penetrate into and below the substrate surface. In Fig. 3, the footprint is shown as being bonded to the surface 18a of the substrate 18, while the image 24 penetrates within the substrate.

In an alternative embodiment of the invention, the information 20 is provided to the label 10 by physically altering the information receiving layer 14 prior to applying the label to a substrate. As shown in exaggerated form in Fig. 4, the layer 14 is subjected to impact printing (e.g. typewriter) or laser ablation to produce the information 20 thereon. The indentations 26 cause a corre-

sponding alteration of the adhesive layer 16 which results in the alteration of the concentration of the marking substance 17 as at 27. Accordingly, it will be appreciated by those of skill in the art that the altered concentration 27 of the marking substance replicates an image associated with the information 20 provided to the layer 14. Once the label is applied to the substrate 18 as shown in Fig. 5, the marking substance migrates to the substrate surface, and thus the surface is marked with a detectable image 28,29 of the information.

Applying such a pre-altered label as shown in Fig. 4 to a substrate would, in time, result in the image on the label being developed on the surface of the substrate. There is a time dependence to the rate at which the image would appear on the substrate. The intensity of the transferred image relates directly as a function to the time dependence of application, the permeability of the adhesive and other components within the label system and the permeability of the substrate surface itself, the type of chemical reaction, if any, that is needed to be performed, and, of course in many cases, the ambient temperature at which the label is applied and maintained.

For illustrative purposes, the image 24 and footprint 25 marked in accordance with Figs. 1-3 is shown in Fig. 6 as a solid impression or positive image of the information provided to the label. The image 28,29 and footprint 25 marked in accordance with Figs. 4-5 is shown in Fig. 7 as an outline, halo, or negative image of the information provided to the label.

The invention is now further illustrated by examples which are not meant to limit the invention. It will be appreciated by those of skill in the art that the chemical nature of the layers and films used in the invention is not critical so long as they have sufficient integrity and compatibility for the intended use of the invention as described herein. The listed percentages are by weight unless otherwise specified.

In one exemplary embodiment, the invention is used for marking automobile parts. Several key components of an automobile have to be marked with a label that has the vehicle identification number (VIN) as the variable input information. This label cannot be removed without permanent changes to the label (tamper evidence) and must leave some "footprint" of the label on the automobile component. This is accomplished by surface printing the VIN on a conventional tamper-evident labeling system and having a UV fluorescent dye dispersed within the pressure-sensitive adhesive which affixes the label to the automobile component. Upon application of the label to a substrate, the UV fluorescent dye migrates to the surface of the substrate. Thereafter, if the label is removed, a footprint of the label would be visible under a long wavelength UV ("black") light. The presence of this footprint means that someone removing the original label would have to more exactly line up a replacement label. While the footprint outlines the adhesive layer contacting the substrate surface, it is desirable to replicate the VIN from the surface of the label to the substrate surface.

A cross sectional view of an exemplary security composite label 30 in accordance with the invention is shown in Fig. 8. The label includes a polyethylene terephthalate (PET) film 31, 1.5 mil thick, is printed with a discontinuous first coating 32 of a material (e.g. cellulostics such as nitrocellulose or ethylcellulose, certain acrylics polymers such as PBA, etc.), which has a low level of adhesion to the film, such that the adhesion strength is less than that to subsequent layers to the substrate. Over the discontinuous first coating 32 is applied a continuous second coating 33 (e.g. amorphous polyester resins such as top coating TC200 as available from Flexcon Co., Inc.) which has good specific adhesion (greater than the adhesion of the discontinuous coating to the PET layer) to both PET and the first coating.

The second coating is micro-embossed as at 34 with a desired holographic image. This process is followed by a metallization process to produce a metallic layer 35 (e.g. aluminum vacuum deposited to a thickness of 50-600°A) over the entire second coating 33. A continuous black coating 36 (carbon black 5-40% by weight) is then dispensed in a polymer with 0.5 - 10% free carboxylation over the metallized layer. Over the black coating is applied a pressure-sensitive adhesive 37 (e.g. acrylic pressure sensitive adhesive V-23 available from Flexcon Co., Inc.), between 0.2-8 mil, containing a long wavelength UV light fluorescent dye 37a, such as Uvitex®, at 0.01-3% by weight of the adhesive, depending upon the substrate's texture and the desired brightness of the image. The entire composite is backed with a siliconized release liner 38, preferably Special 50K-8 liner available from Flexcon Co., Inc.

After removing the release liner, the label is applied to the substrate. The label surface is then ablated with the VIN via a directed radiate energy source, such as a Bassel laser (type YAG or CO_2 laser, 10-18 amps, 1000Hz to continuous, preferably between 2500-5500Hz) at a burn rate of between 5mm/sec to 1400mm/sec, preferably between 25mm/sec-350mm/sec. This results in a label in which there is a VIN within the structure of the label of the material, not just on the surface of the label. The VIN cut into the label surface constitutes an additional tamper-evident or anti-transfer feature, independent from any other tamper-evident or anti-transfer feature, and independent from any other tamper-evident mechanism such as the use of the described low adhesion discontinuous coating.

The sudden concentration of heat during the ablating process drives a disproportionate amount of the UV fluorescent dye into the finish of the car. Over time, the dye from the surrounding area of the ablation will migrate into the car's finish. However, the visually detectable results would be a slightly higher intensity where the ablation took place. Accordingly, more than just the footprint of the label would be left after the removal of

the label, and the variable information on the label would be marked on the substrate as a detectable image.

In another exemplary embodiment of the invention, using the same label materials as in the previously described exemplary embodiment, the VIN is ablated in the label before application to the automobile component. Depending upon the position of the UV fluorescent dye within the adhesive layer, the other parts of the chemical matrix. etc., a decreased concentration of the fluorescent dye would result in the area that had been physically altered by impact or ablation. Thus, when the label is subsequently applied to the substrate, there would be a lower concentration of the dye under the VIN and hence, a negative image of the information is obtained.

Other factors which determine whether the image to be transferred is a positive or negative are: (1) the depth of the cut into the composite label, (2) the presence or absence of heat directing layers (e.g. black coatings or fillers in the adhesive), (3) the presence or absence of carriers or penetration enhancers (e.g. solvents, liquid phthalate plasticizers, surfactants, polyesters, acrylic ester monomers and oglimers, etc.) which promote the rate of migration of the UV fluorescent dye into the surface of the substrate, (4) micro-encapsulated dyes, ink, pH adjusters, which upon impact or thermal activation would penetrate and mark the substrate surface, and (5) the substrate surface contains a pH or other chemically sensitive material which would be altered by the migrating marking substance from the label (again, activated by temperature, pressure or removal by die cutting or stamping).

In the exemplary embodiments described above, the physical alteration of the VIN into the holographic film eventually results in a unique label. The physical distinction of parts of the hologram by the physical alteration process make obtaining a true copy very difficult at best. Another manifestation of the invention is its use as a stencil, i.e. a pre-activated label with indicia accomplished by the methods previously described, applying the label to the substrate, provide time for image transfer to occur, then removal of the label or stencil. In this particular aspect of the invention, the label is preferentially not tamper-evident.

Another aspect of this embodiment of the invention is a label which is used for marking glass or like materials. A label is provided which has incorporated within the adhesive layer a fluoridating agent such as sulfurhexafluoride (0.1-2% by weight) and a micro-encapsulation of an activating acid such as tartaric acid in the presence of the inorganic or organic fluorine source. The materials are then activated by the methods previously described, e.g. impact or ablation, to form hydrogenfluoride (HF) which will serve as a chemical etchant. The label is then applied to a glass surface, such as automobile glass. Following the proper reaction time, based on concentration and ambient conditions, the composite label is removed from the glass. This results in the etching of the windshield, rear window or side glass with information such as a VIN, and thus making theft and the chopping of the automobile of less value to the potential thief. By using the same techniques, more graphic or aesthetic designs can be etched into glass as well as into metals.

In yet another exemplary embodiment of the invention, there is provided a composite label consisting of a 2.4 mil rigid white PVC film, coated on one side with a pressure-sensitive adhesive, such as adhesive V-200W available from Flexcon Co., Inc., and containing a UV fluorescent dye, such as Uvitex® (0.001 - 3% by weight total adhesive). The adhesive layer consists of an acrylic based coat weight between 0.2 and 5.0 mil depending upon the texture of the substrate. The adhesive layer is covered with a conventional release liner. Information such as identification indicia is provided to the label by stamping out or laser ablation, thus leaving a void within the label structure. The label is applied to the substrate that is being identified. Over a period of time, in this case 10 days, at ambient room temperature with a substrate having a surface layer (less than 2% of the total composite) of polystyrene, a negative image of the indicia is marked on the substrate surface when the label is removed and the surface is exposed to a UV light source, such as black light. Hence, there is no UV fluorescence where there was a void within the label.

In another aspect of the invention, the same labeling composite as in example 3 is used and subjected to a high impact printer. The surface of the information receiving layer is permanently deformed or compressed under the impact. When the label is applied to a substrate, a contrasting image (lighter UV fluorescence) is found after 10 days at ambient conditions upon removal of the label and examination of the substrate with a UV light source.

In yet another exemplary embodiment of the invention, the previously described composite label has an adhesive layer with a marking substance dispersed therein, the marking substance being contained in micro-encapsulants. The marking substance can be any of the previously described substances including pH sensitive dyes or UV fluorescent dyes which are encapsulated in shells of, for example, polymer material (cellulostics, acrylics, styrenics, etc.), which would have specific sensitivities to impact or heat generated around a laser ablation. In a further aspect of the invention, the micro-encapsulants have their shells impregnated with specific substances such as laser dyes (e.g. Coumarin 6, Oxazine 1 Perchlorate, etc. as available from Kodak Co.), which would preferably absorb laser radiant energy. This effect can be made more specific to a particular frequency, although generally a black coloration would be appropriate as a broad band radiant energy collector.

Another exemplary embodiment of the invention is shown in Fig. 9, and includes a composite label 40 having an information receiving layer 44 with a top surface 44a and a bottom surface 44b, and an adhesive layer

46 which includes a marking substance 46a dispersed therein. The specific layer materials and compositions can vary for this composite as described in accordance with the previous examples. The migration of the marking substance to the substrate 18 is blocked by a selectively coating or printing the adhesive layer with a polymer layer 48. The polymers providing the desired migration blocking effect include acrylics, polymethylmethacrylate, amorphous polyester resins or other barrier polymers such as PVDC, PVC, PVF, etc. The polymer layer serves to slow the resulting marking substance transmission rate to less than the transmission rate through the unobstructed portions of the adhesive layer. Since the marking substance will migrate through the unobstructed portions of the adhesive layer more efficiently, the resulting marking is a negative image of the information provide to the label.

The foregoing description has been set forth to illustrate the invention and is not intended to be limiting. Since modifications of the described embodiments incorporating the spirit and substance of the invention may occur to persons skilled in the art, the scope of the invention should be limited solely with reference to the appended claims and equivalents thereof.

Claims

1. A labeling composite, comprising:

   an information receiving first layer having a top surface onto which information is provided and a bottom surface; and

   an adhesive second layer provided on said bottom surface for adhering said first layer to a surface of a substrate, said adhesive second layer including substrate marking substance dispersed therein, said marking substance serving to mark the portions of said substrate surface covered by said second layer in a non-uniform manner providing a detectable image of said information upon removal of said composite from said substrate surface.

2. The labeling composite of claim 1, wherein said substrate marking substance is adapted to migrate through said second layer to said substrate surface.

3. The labeling composite of claim 2, wherein said information is provided by physically altering said first layer.

4. The labeling composite of claim 3, wherein the physical alteration of said first layer alters the concentration of said marking substance dispersed within said adhesive layer in accordance with said information.

5. The labeling composite of claim 4, wherein the altered concentration of said marking substance results in an enhanced migration of said substance to said substrate surface so as to mark said substrate surface with said image of said information.

6. The labeling composite of claim 1, wherein said marking substance comprises dyes.

7. The labeling composite of claim 1, wherein said marking substance comprises ultra-violet fluorescent dyes.

8. The labeling composite of claim 2, wherein said second layer further comprises materials for enhancing or impeding the migration of said marking substance.

9. The labeling composite of claim 1, wherein said information is provided to said first layer prior to application of said labeling composite to said substrate surface.

10. The labeling composite of claim 1, wherein said information is provided to said first layer subsequent to application of said labeling composite to said substrate surface.

11. The labeling composite of claim 1, wherein said information is provided to said first layer by impact printing said first layer.

12. The labeling composite of claim 1, wherein said information is provided to said first layer by ablating said first layer with a laser.

13. A method of producing a label, comprising:

    providing an information receiving first layer having a top surface onto which information is provided and a bottom surface; and

    applying an adhesive second layer on said bottom surface which accommodates the adherence of said first layer to a surface of a substrate, said adhesive layer including substrate marking substance dispersed therein, said marking substance being adapted to migrate through said adhesive layer to said substrate surface to mark the portions of said substrate surface covered by said second layer in a non-uniform manner providing a detectable image of said information upon removal of said composite from said substrate surface.

14. A method of labeling, comprising:

    providing an information receiving first layer having a top surface onto which information is

provided and a bottom surface;
applying an adhesive second layer on said bottom surface to define a composite label, said second layer accommodating the adherence of said first layer to a surface of a substrate, said second layer including substrate marking substance dispersed therein, said marking substance migrating to said substrate surface to mark the portions of said substrate surface covered by said second layer in a non-uniform manner providing a detectable image of said information upon removal of said composite label from said substrate surface;
applying said composite label to said substrate surface; and
physically altering said top surface of said first layer to create said information thereon, said physical alteration of said top surface acting to alter the concentration of said marking substance within said adhesive layer in accordance with said information, whereupon the altered concentration of said marking substance results in an enhanced migration of said substance to said substrate surface and thus said substrate surface is marked with said image of said information.

15. The method of claim 14, wherein said step of applying said composite label to said surface substrate occurs prior to said step of physically altering said first layer.

16. The method of claim 14, wherein said step of applying said composite label to said surface substrate occurs subsequent to said step of physically altering said first layer.

17. The method of claim 14 further comprising removing said composite label from said substrate surface, thus leaving only said image of said information marked on said substrate surface.

18. The method of claim 14, wherein said marking substance comprises ultra-violet fluorescent dyes.

19. The method of claim 18 further comprising the step of irradiating said substrate surface with an ultraviolet light source in order to detect said image of said information.

20. The method of claim 14, wherein said step of physically altering said top surface of said first layer further comprises ablating said top surface with a laser.

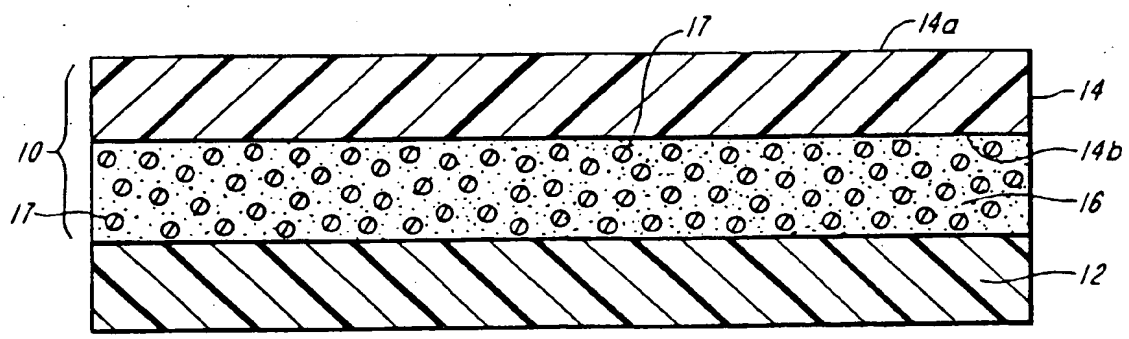

FIG. 1

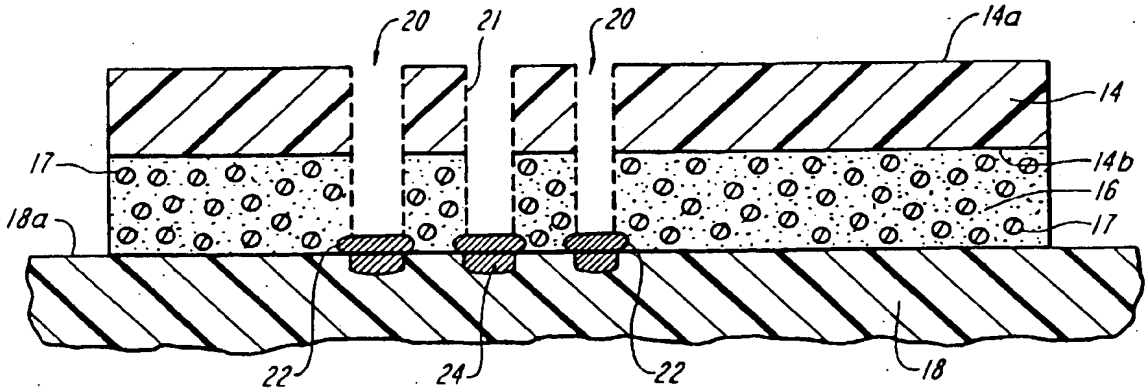

FIG. 2

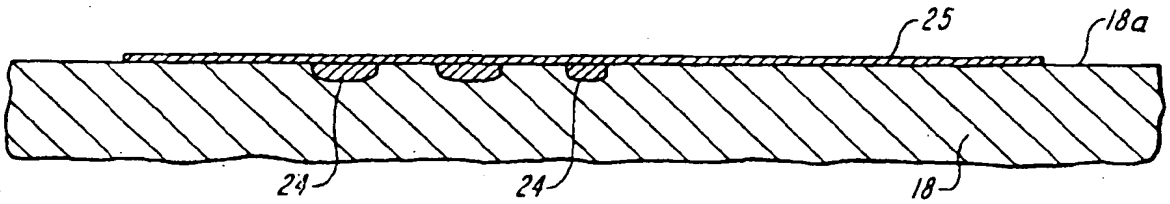

FIG. 3

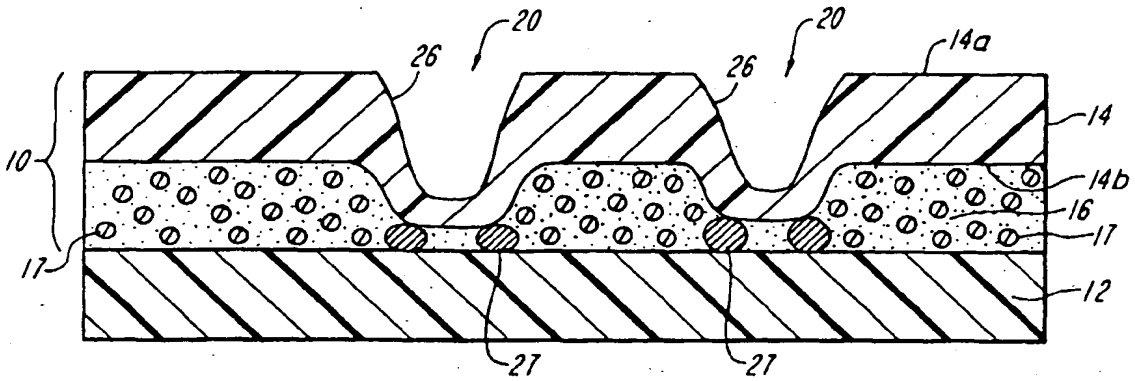

FIG. 4

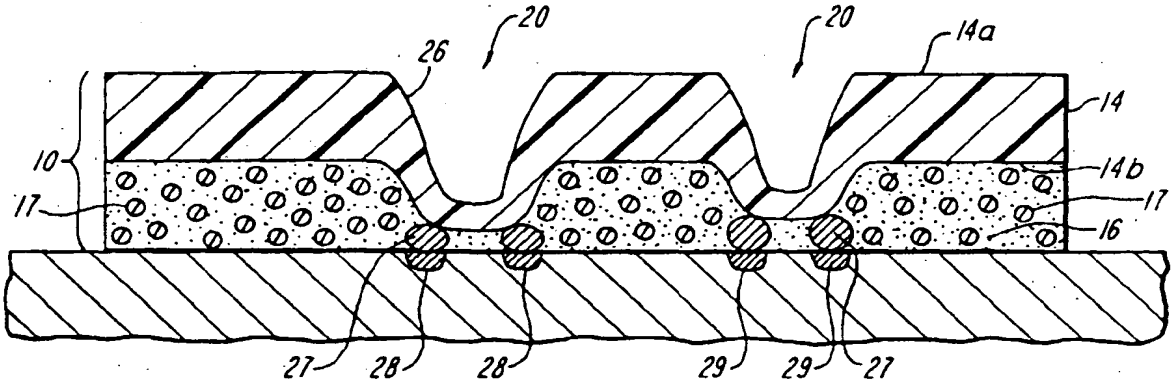

FIG. 5

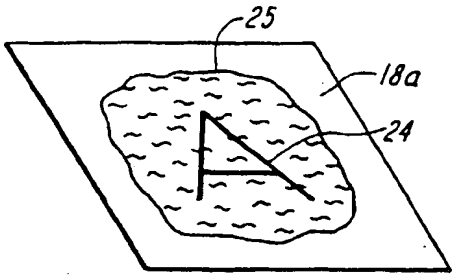

FIG. 6

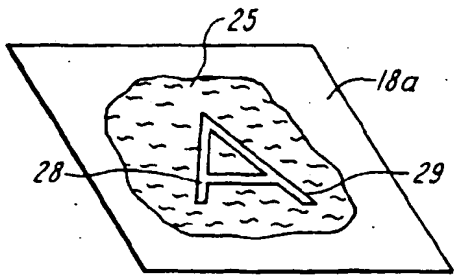

FIG. 7

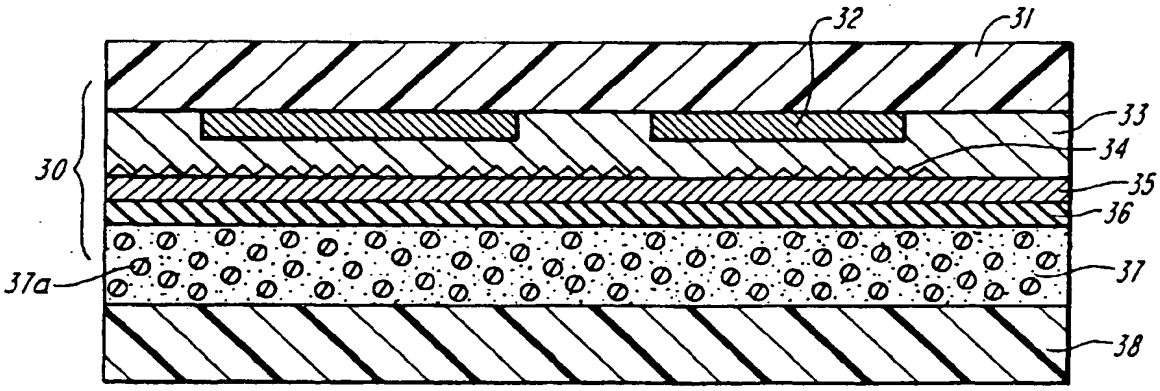

FIG. 8

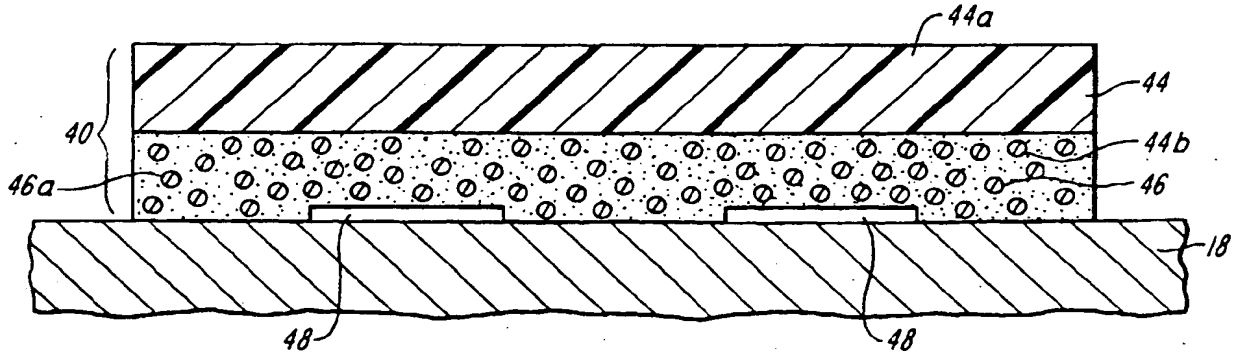

FIG. 9

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 85 0138

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 4 841 652 A (SAKASHITA ET AL.)	1-9,11, 13,14, 16-18	G09F3/02
A	* column 2, line 12 - column 6, line 24; figures 1-7 *	19	
A	DE 38 13 303 C (SCHREINER ETIKETTEN UND SELBSTKLEBETECHNIK GMBH & CO.) * column 1, line 53 - column 3, line 4 *	1-7,9, 11,13, 14,16-19	
E	WO 97 40484 A (MINNESOTA MINING AND MANUFACTURING CO.) * page 4, line 13 - line 32 * * page 6, line 11 - page 7, line 32; figures 1,2 *	1,2,6-9, 13,14, 16-19	
A	EP 0 326 303 A (MOORE BUSINESS FORMS, INC.) * page 3, line 40 - page 4, line 56; figures 1-5 *	1,6,10, 13-15,17	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
G09F
B41M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	10 February 1998	Taylor, P

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